

Metrics For Addressing ESA SSA End User Needs

A Glover, J Luntama

ESA SSA Programme Office, ESOC, Germany

Objectives of the SSA Programme



“The objective of the Space Situational Awareness (SSA) programme is to support the European independent utilisation of, and **access to, space** for research or services, through the **provision of timely and quality data**, information, services and knowledge regarding the **space environment**, the **threats** and the sustainable exploitation of the outer space **surrounding our planet Earth.**”

- **ESA Ministerial Council
November 2008**



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ESA SSA SWE Segment Objectives



Detection and forecasting of Space Weather events and their effects on European space assets and ground based infrastructure

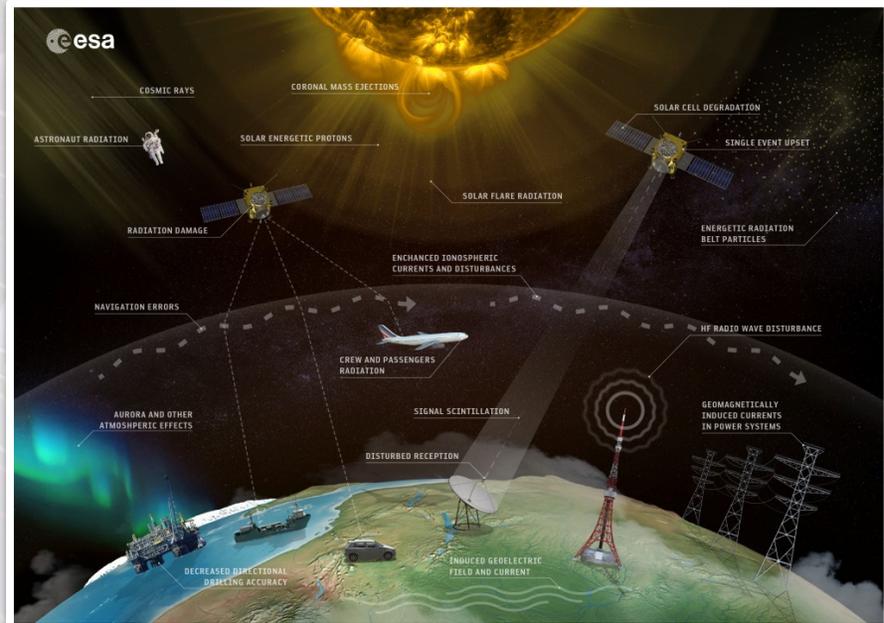
Developments target 8 distinct user domains

39 tailored services:

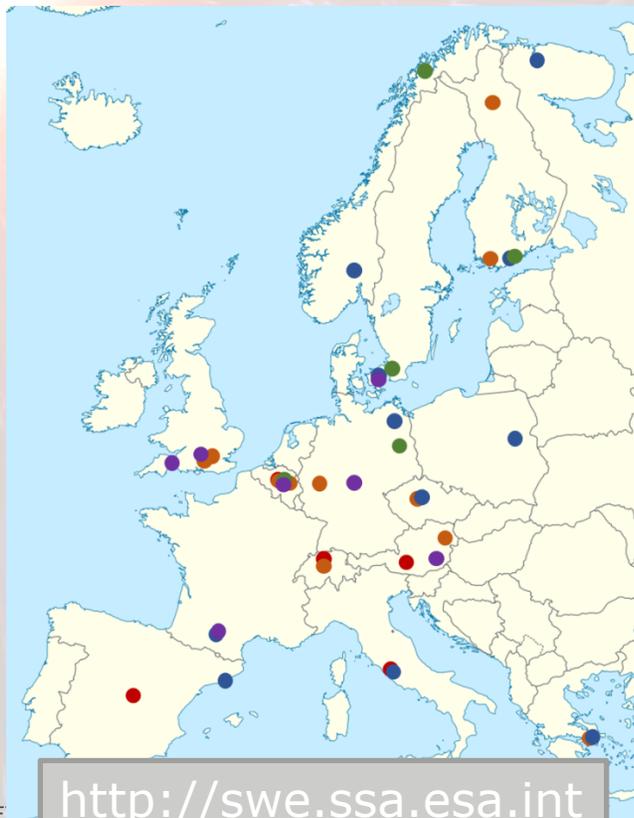
- Products & toolkits
- Alerting
- User support

End users:

- Continuous dialogue & consultation
- Inform & improve requirements baseline



SSA SWE Network: A unique Space Weather Service System



<http://swe.ssa.esa.int>

- Data archives**
- SSA SWE Data Centre (Redu)
 - Federated data repositories

- SSA SWE Coordination Centre**
- User Helpdesk
 - Space Pole, Belgium

SWE Expert Service Centres (ESCs)

Solar Weather	Ionospheric Weather	Space Radiation	Geomagnetic Conditions	Heliospheric Weather
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European expert groups and centres of excellence

Sensor systems

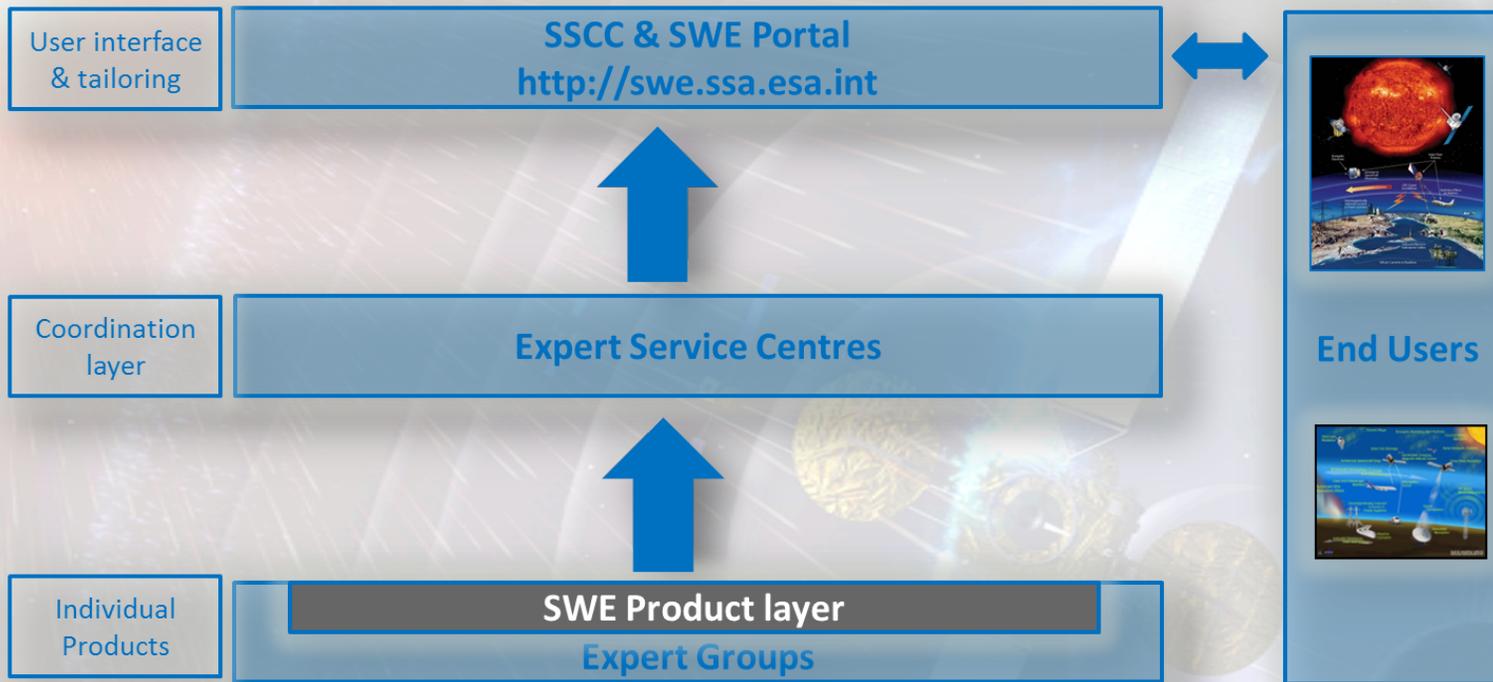
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SWE Services Business Logic



Building a Federated System

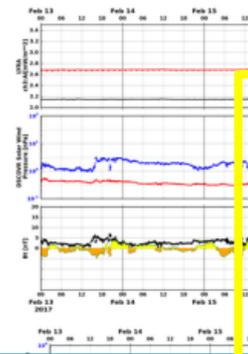


- Utilisation of existing assets and expertise:
 - Many high quality assets
 - Widely different heritage
 - Widely different capabilities
- Networking + targeted development
- Development of network structure towards SWE services
- SWE Services:
 - products
 - Tools
 - Alerts/reporting
 - User support
- Current status: >115 elements, 20 service pages

Spacecraft Operation - In-orbit environment and effects monitoring

Service User Manual Products Tools Alerts Auxiliary Info

The service "Spacecraft Operation - In-orbit environment and effects monitoring" aims to provide a near real-time estimate of the space environment and its effects actually experienced in regard to the operation of the spacecraft. To obtain a near real-time quantitative assessment of the space environment, the SSA SWE network provides monitoring of phenomena that can lead to potentially hazardous and sudden effects on spacecraft (e.g. magnetic storms, substorms, high-speed streams, solar energetic particle events, Earth-directed CMEs, meteor streams, and debris clouds). This continuous real-time monitoring of the space weather environment provides the relevant information to take informed decisions related to spacecraft operations and helps with the correlation of results in future analysis. Real-time data allows the system to provide forecast and near real-time assessment of the effects of ionospheric disturbances on spacecraft operations, nowcast and forecast of meteoroid and



- About SWE
 - What is Space Weather
 - SSA Space Weather Activities
 - Current Space Weather
 - Contact
- Service Domains
 - Spacecraft Design
 - Spacecraft Operation
 - Human Space Flight
 - Launch Operation
 - Transionospheric Radio Link
 - Space Surveillance and Tracking
 - Power Systems Operation
 - Airlines
 - Resource Exploitation System Operation
 - Pipeline Operation
 - Auroral Tourism Sector
 - General Data Service
- Expert Service Centres
 - ESC Solar Weather
 - ESC Space Radiation
 - ESC Ionospheric Weather
 - ESC Geomagnetic Conditions
 - ESC Heliospheric Weather
- Other Resources
 - Documents
 - SWWT
 - SWEN Newsletter
 - Upcoming Events
- Sign-In

	GEN alm	GEN for	GEN lst	NSO air	NSO pow	NSO res	SCD arv	SCD pla	SCD pst	SCH pst	SCO orb	SCO pla	SS arv
ANeMoS	✓	✓	✓	✓									
AVIDOS		✓	✓	✓									
COMSESP		✓	✓										
EDID			✓	✓			✓			✓	✓	✓	✓
EPT			✓	✓			✓		✓	✓	✓	✓	✓
SEDAT				✓			✓		✓	✓	✓	✓	✓
SPENVIS							✓		✓	✓	✓	✓	✓
UTU-SEP							✓		✓	✓	✓	✓	✓
IMSSL							✓		✓	✓	✓	✓	✓
RADSpace										✓	✓	✓	✓
SEISOP													
RADSEP				✓									
SEPEN							✓		✓	✓	✓	✓	✓
SPM		✓					✓		✓	✓	✓	✓	✓
SREM							✓		✓	✓	✓	✓	✓



Capability Assessment



- Measure maturity of services and constituent elements with respect to SWE requirements baseline
- Provide clear accuracy and reliability information to SWE users
 - Product maturity
 - How well does the product match the target requirement? Scope... accuracy...timeliness
 - Service maturity
 - Combination of available product maturity + operational implementation



Product Accuracy within Expert Service Centres



- Develop common practice and common approach to assessing accuracy of comparable products
- First case study initiated within Ionospheric Weather Expert Service Centre (*lead: DTU*)
 - ✓ TEC map focus
 - ✓ Validation against independent reference data and tbc modelling
 - ✓ Selection of appropriate metrics & periods
- Extend approach to wider network in P3

Ref.	Product Name	Provider
I.101	IMPC – TEC Map (Europe), current	DLR
I.103	IMPC – TEC Map (Global), current	DLR
I.103	IMPC – TEC Map (Global), current, beta version	DLR
I.107	VTEC maps (Northern Europe)	NMA
I.121	IONMON TEC maps	ESA
I.122e	DC-IV/ISM TEC and Err(TEC) maps	CLS/IEEA
I.117	Near real-time TEC maps (Europe)	INGV/NOA



Product & Service Development Lifecycle

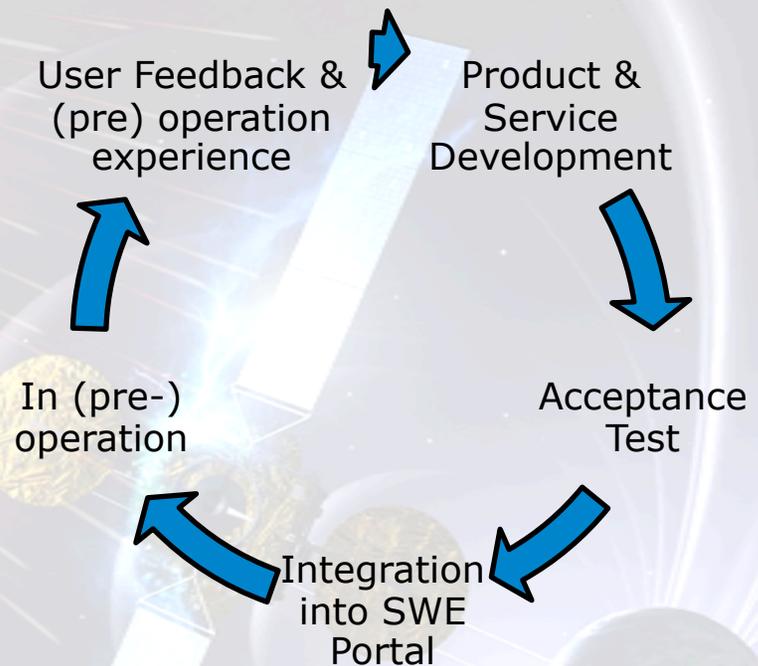


Establishment of a process whereby SWE products & services are tested with real users in the loop

New and upgraded products & service pages subject of user test campaigns Dec 16 - Apr 17

Test campaign Results :

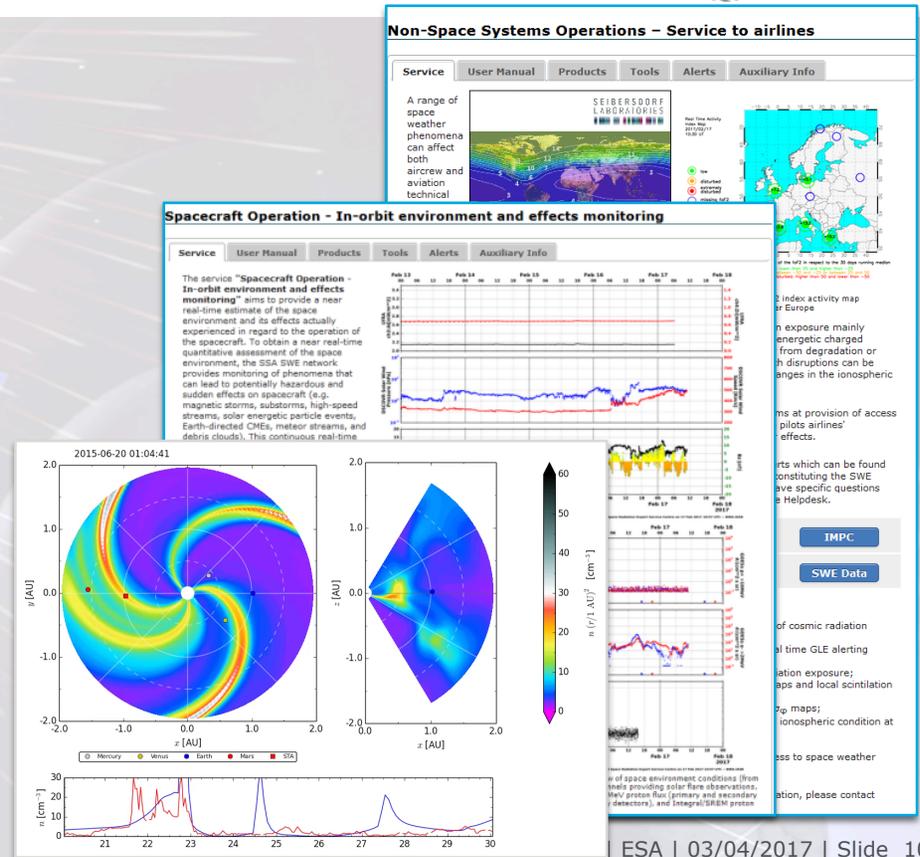
- Requirements for improved products & services
- Feed into longer term definition and development planning



SWE Implementation Targets for Period 3 (2017-2019)



- Establish robust R2O process for models and tools developed within and outside the Programme
- Mature elements of the SSA SWE system for transitioning to operations
- Develop and validate improved services for key user domains => develop required models and applications



Summary



- SWE Network has developed rapidly during SSA Period 2 (2013-2016)
 - >40 teams proving >115 products plus user support constituting 20 initial services
- Now maturing, continuing to grow and addressing transition of elements towards operations as part of Period 3 (2017 – 2019)
- Selection and utilisation of appropriate metrics vital to ensure effective benchmarking, reliable and consistent accuracy information
- Further SSA SWE capability assessment discussion:
 - Dedicated working meetings at ESWW14 (<http://stce.be/esww14>)
 - SWE Network (~annual) “Thematic Workshops”





THANK YOU

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